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worth while to cut out the writing in wood-blocks, or fix in metal letters for each particular sentence to be introduced.

Another mode I propose is, to have movable types introduced into a frame, so arranged as to form a substitute for one of the numerous blocks required in cases where the pattern is made up of a variety of colours. Thus, when as many copies as are likely to be required at the time have been printed, the type is to be distributed, and again set up for another piece of information, while the rest of the pattern is printed with the different blocks as usual.

A third mode which I propose is to print the patterns complete in the ordinary way, leaving, however, spaces for the writing to be inserted according to the style and fancy of individuals. This is by no means so expensive a method as persons unacquainted with the process would be led to suppose.

No. XXVII.

ON A PLAN OF ECONOMISING FUEL IN THE
BOILERS OF LOCOMOTIVE ENGINES.

By C. TETLEY.

April 3, 1844.

WILLIAM FOLE, ESQ. F.R.S. V.P. IN THE CHAIR.

Abstract.

“THE evaporating power of a boiler,” observes the author, “is dependent chiefly on three causes:—

- “ 1. The amount of boiler surface exposed to the reception of heat.

“ 2. (And very materially) On the shape of the boiler ; and

“ 3. On the intensity of the heat.

“ The heat derived from that part of the boiler immediately over and about the fire, I call (according to usage) *radiating heat*, while the heat derived from the tubes or flues I call *carried heat*.

“ The improvement in boilers for the rapid evaporation of water, and for the economy of fuel, consists in dividing the boiler into two or more compartments, of different heating temperatures, having channels for feeding the compartments from that or those containing water of a lower temperature.

“ The first partition is placed vertically over the water-space at the back of the boiler, the top of which reaches somewhat above the water-line, and the bottom below the level of the fire-bars, but leaving a passage for the water beneath it.

“ The second partition reaches from the bottom of the tubular part of the boiler to a little above the level of the fire-box, and removed but a short distance from the first partition.

“ The third partition is placed in the middle of the tubular boiler, and, as the first, runs up above the water-level.

“ A communication is formed for the supply of water by a pipe running from the compartment nearest the chimney-box into the middle compartment, the top of such pipe being fixed just below the water-level, and the bottom thereof at a point near the lower part of the middle compartment.

“ On evaporation taking place, the steam will diffuse

itself over the top of the partitions nearest to the fire-box and that nearest to the smoke-box, so as to maintain the same pressure on the surface of all the water; thus the water contained over the top, and in the water-spaces at the front, back, and sides, of the fire-box, is all exposed to the direct action of the fire, or to *radiating* heat, and separated from that which receives only *carried* heat. On the other hand, the water contained in that part of the boiler between the partition introduced nearer to the fire-box and the end of the boiler by the smoke-box is exposed only to the reception of *carried* heat, or heat of a lower temperature than in the part last described; the consequence is that evaporation commences, first in that part over the fire-box, and, as the water there becomes wasted, more to supply its place passes from the second compartment down between the two partitions nearest the fire-box. Now, as this feed-water to supply the first division is received from the surface of the water between the partition nearest the fire-box and that nearest the smoke-box, it will be charged with heat almost or entirely at the evaporating point before it enters the first compartment, because, as the separate particles become heated in the second division above the surrounding portion, they rise to the surface, and, as the middle partition has its upper edge below the water-level, the surface-water passes over it, and descends to the bottom of the fire-box partition and passes under it. As the water leaves the second compartment, either by evaporation, or to feed the first, that loss or waste is replaced by water descending from the upper regions of the water in the third compartment down the pipe or channel, by virtue of its tendency to preserve its own level. The third compartment is again fed through another pipe by

a force-pump, or other usual means ; this pipe may be joined in any convenient part of the said compartment, but it is preferred that it should be at or near the bottom. Any suitable number of partitions may be similarly introduced, although in this description of boiler, when of moderate length, I am of opinion that two compartments are enough to serve all purposes of economy.

“ If we examine, for the sake of contrast, what takes place in the same boiler when constructed without such divisions, we shall find an operation to take place as follows: the boiler being filled to its proper height with water, and the fire lighted, the water immediately surrounding the fire-box receives its heat with greater rapidity, in the proportion of 3 to 1 of each square foot of the fire-box, as compared with the same extent of the tubular part ; now, as each particle of water around the fire-box becomes charged with heat, it becomes specifically lighter, and, therefore, rises into the higher regions, and intermixes with the water in the tubular part, until at the last the whole is brought up to the evaporating point. The engine being then set to work, a continual injection of fresh water takes place to supply the loss arising from evaporation. This feed-water, being colder than that already heated in the boiler, is of greater specific gravity, in virtue of which it will find its way to the lowest level in the boiler, namely, around the fire-box. A circulation is thus established by which a current of the coldest portion of water is continuously driven into the spaces around the fire-box, there receiving a surcharge of heat, the excess of which converts a portion of the water into vapour, while the remaining portion, not converted into steam, ascends into the tubular part. It is evident that the feed-water by this process is charged with heat to the

evaporating point by the fire-box, and not by the tubes, that is all feed-water entering the boiler after the engine is set to work. The tubular part is therefore supplied continuously with water heated in the fire-box. Now the question is, what loss of fuel arises from this?

“ To solve this, let us call to mind the circumstance, that the quantity of heat contained in a pound of steam never varies ; it is always the same in quantity, whatever be the density and temperature of such steam, and about 1200° is fully more than the average allowed by different experimenters. Now let us suppose the feed-water to be injected at a temperature of 60° , and also that the steam be drawn off at a pressure of 60 lbs. per inch, which would give a temperature for the water in the boiler of 305° before evaporation could proceed ; the water in the whole boiler, the tubular part as well as around the fire-box, would have received $305^{\circ} - 60^{\circ}$ for the temperature of the feed-water, or 245° from the fire-box. The water surrounding the tubes being thus charged with heat by the fire-box, till it reaches the temperature of 305° , it could receive no further accession of heat from the tubes, unless their temperature exceeded 305° ; but, if the tubes did exceed that temperature, then the water would be ready to abstract the excess above 305° ; therefore 305° must always be deducted from the actual temperature of the flues, as waste for heat which is passing into the chimney unabsorbed by the water. But if the operation be reversed, and the feed-water injected at the said temperature of 60° , and kept separated from the water surrounding the fire-box, then it will abstract all the heat of a higher temperature than 60° . Hence it is evident that 245° more heat is now abstracted from the tubes than was abstracted in the former case. In the

former case 245° passed into the chimney which is now passing into the water. If this water, which in the last case abstracted 245° from the tubes, be now conducted into the spaces around the fire-box, it will require 245° less to convert it into steam. If a total heat of 1200° are required for its constitution as steam, then deduct 60° from 1200° and we have 1140° as the amount of heat required from the fire-box. If out of 1140° we effect a saving of 245° , we save 21 per cent of fuel.

“By this improvement, therefore, we prevent the deposit of sediment amongst the tubes to the same extent that we remove the evaporation from that part to the fire-box, which latter may be more easily cleaned and repaired, if constructed with that view.

“Secondly, we get up steam much more rapidly.

“Thirdly, we have in one compartment water free from turbulent motion, in consequence of which the action of a float for regulating a feed-apparatus will be much more certain.

“And, lastly, we have an important saving in fuel.”

No. XXVIII.

ON WROUGHTON'S SELF-ACTING GLASS VENTILATOR.

WROUGHTON'S self-acting glass ventilator consists of a mahogany vertical frame, seventeen inches high, and fourteen inches wide, standing on a platform fourteen inches long and eighteen inches wide. In the frame is fixed a plate of glass, in which are ten horizontal apertures, each two inches and a half long, and half an inch wide. On the internal side of the glass are four